CLAIMS:

1. Apparatus for obtaining a posterior probability distribution $P(\boldsymbol{p}|D)$ relating to an attribute or attributes θ quantized into I values $(\theta_1,\ldots,\theta_I)$ of a succession of events each one of which is one of the types $(E_1, E_2, \ldots, E_I)$ in which the events generate measurable physical reactions, the posterior probability distribution $P(\boldsymbol{p}|D)$ being on a distribution $P(\theta)$ of θ, where $P(\theta)$ is represented by $\boldsymbol{p} = (p_1, p_2, \ldots p_I)$ where $p_i = P(\theta_i)$; the apparatus comprising:

means for detecting the physical reactions generated by the events and generating measurements $D=(D_1, D_2,\ldots,D_j,\ldots)$ in response to the detected reactions; and

inferential processing means for deriving values $P(p_i= q_{i,k}|D)$ at points $q_{i,k}$ of the marginal distributions $P(p_i|D)$ of the probability distribution $P(\boldsymbol{p}|D)$ for the distribution of the attribute or attributes θ of the events by carrying out a Bayesian inferential process utilising the values $(D_1, D_2,\ldots D_j\ldots)$, the marginal values $P(p_i = q_{i,k})$ of a preset prior probability distribution $P(\boldsymbol{p})$ which marginal values define the complete preset prior probability distribution, and a stored set of values $P(D_j|E_i)$ representing a range of probability distributions for the occurrence of each of the observed measurements D from the events of each type

of E occurring, the inferential process being an iterative process in which the values $P(p_i = q_{i,k} | D_1, \ldots, D_j)$ of the marginals $P(p_i | D_1, \ldots, D_j)$ after the jth event are generated from the values $P(p_i = q_{i,k} | D_1, \ldots, D_{j-1})$ of the marginals $P(p_i | D_1, \ldots, D_{j-1})$ prior to that event.

2. Apparatus according to claim 1, wherein the generating means are adapted to generate an analog signal and include analog-to-digital conversion means for converting the analog signal into a digital signal and means for compressing the data content of the digital, the output of said compression means being connected to said processing means.

3. Apparatus according to claim 2, wherein the compression means are adapted to compress the digital output of the ADC means to generate the value D by taking quantized transformed log moments.

4. Apparatus according to claim 3, wherein the compression means obtain the quantized transformed log moments by carrying out the steps set out as follows:

$$\bar{y} = \frac{1}{M}\sum_{m=1}^{M} y_m$$

$$u_n = \frac{1}{M}\sum_{m=1}^{M}\left(y_m - \bar{y}\right)^n$$

$$z_m = y_{m+1} - y_m$$

$$\bar{z} = \frac{1}{M-1}\sum_{m=1}^{M-1} z_m$$

$$u_n' = \frac{1}{M-1}\sum_{m=1}^{M-1}\left(z_m - \bar{z}\right)^2$$

$$\mathbf{u} = \begin{pmatrix} \log|u_2| \\ \log|u_3| \\ \log|u_2'| \end{pmatrix}$$

$$\mathbf{v} = T\mathbf{u} + t$$

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5. Apparatus according to ~~any preceding~~ claim 1, wherein the preset prior probability distribution is of Dirichlet form or is a mixture of Dirichlets.

6. Apparatus according to claim 5, wherein the preset prior probability distribution is

$$P(\mathbf{p} \mid \sum_i p_i = 1) = \frac{\Gamma(\sum_i \alpha_i)}{\prod_i \Gamma(\alpha_i)} \prod_i p_i^{\alpha_i - 1}$$

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where all $\alpha_i > 0$.

7. Apparatus according to claim 1 ~~any one of the preceding claims~~, wherein the marginals are updated using an algorithm carrying out the equation

$$\log P(p_i \mid D) = \log P(p_i) + \log(1 - p_i) + f\left(\log\frac{p_i}{1-p_i} - \log\frac{P(E_i)}{1-P(E_i)} + \log\left(\frac{P(D_{i_k} \mid E_i)P(E_i)}{\sum_{k \neq i} P(D_{i_k} \mid E_k)P(E_k)}\right)\right) + K$$

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claim 1

8. Apparatus according to ~~any one of the preceding claims~~, wherein the generating means comprise a means defining a passage through which particles to be measured must pass, means for irradiating the particles, and means for detecting perturbations in the radiation caused by the particles to generate an analog signal.

9. Apparatus according to claim 8 wherein the means for irradiating the particles comprise a source of monochromatic light adapted to produce a structured light field in a measurement volume in said passage, particles in use passing transversely through the structured light field.

10. A method of obtaining a posterior probability distribution $P(\mathbf{p}|D)$ relating to an attribute or attributes θ quantized into I values $(\theta_1,\ldots,\theta_I)$ of a succession of events each one of which is one of the types $(E_1, E_2, \ldots, E_I)$ in which the events generate measurable physical reactions, the posterior probability distribution $P(\mathbf{p}|D)$ being on a distribution $P(\theta)$ of θ, where $P(\theta)$ is represented by $\mathbf{p} = (p_1, p_2, \ldots p_I)$ where $p_i = P(\theta_i)$; the method comprising:

detecting the physical reactions generated by the events and generating measurements $D=(D_1, D_2,\ldots,D_j,\ldots)$ in response to the detected reactions; and

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deriving values $P(p_i = q_{i,k}|D)$ at points $q_{i,k}$ of the marginal distributions $P(p_i|D)$ of the probability distribution $P(p|D)$ for the distribution of the attribute or attributes θ of the events by carrying out a Bayesian inferential process utilising the values $(D_1, D_2, \ldots D_j \ldots)$, the marginal values $P(p_i = q_{i,k})$ of a preset prior probability distribution $P(p)$ which marginal values define the complete preset prior probability distribution, and a stored set of values $P(D_j|E_i)$ representing a range of probability distributions for the occurrence of each of the observed measurements D from the events of each type of E occurring, the inferential process being an iterative process in which the values $P(p_i = q_{i,k}|D_1, \ldots, D_j)$ of the marginals $P(p_i|D_1, \ldots, D_j)$ after the jth event are generated from the values $P(p_i = q_{i,k}|D_1, \ldots, D_{j-1})$ of the marginals $P(p_i|D_1, \ldots, D_{j-1})$ prior to that event.

11. A method according to claim 10, wherein an analog signal is generated by the events being measured which signal is converted into a digital signal, and the digital signal is compressed prior to the inferential processing.

12. A method according to claim 11, wherein the digital signal is compressed by taking quantized transformed log

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moments.

13. A method according to claim 10 ~~any one of claims 10 to 12~~, wherein the preset prior probability distribution is of Dirichlet form or is a mixture of Dirichlets.